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10/553746

JC20 Rec'd PCT/PTO 18 OCT 2005

DESCRIPTION

PACKAGE AND METHOD FOR PRODUCING THE SAME

Technical Field

The present invention relates to a package accommodating an article such as a battery and a method for producing the same.

Background Art

Product packages accommodating articles such as batteries, daily necessities including facial cleansing items, and processed foods have been widely used. From the viewpoint of effective display at stores/shops and low cost, blister packs are widely used for the containers of product packages. The product packages employing blister packs are composed of a blister pack, a laminate layer and a backing sheet laminated in this order.

More specifically, a print is given on both surfaces of the backing sheet. The blister pack and the laminate layer are bonded by heat sealing. The laminate layer and the backing sheet are adhered by an adhesive. This yields a complicated laminate structure composed of the blister pack, the laminate layer, the adhesive layer, the printing layer, the backing sheet and the printing layer.

Moreover, the existence of the adhesive layer is

problematic because it makes the structure complicated and increases the cost. Particularly because two different adhesion methods are used, the production process is complicated.

Further, in these days, considering the consequences to the natural environment, biodegradable resins capable of being decomposed and disappearing in the natural environment with the passage of time are being used as the material for product packages in place of conventional thermoplastic resins such as polyethylene and polyethylene terephthalate (PET) (see Patent Documents 1 and 2, for example). The use of such biodegradable resins is accompanied by the problems that they are difficult to control because the temperature range in which they are heat sealed is limited, and that the use thereof can cause variations in adhesion strength and quality.

Further, adhesives have poorer adhesion strength than heat sealing. The fact is that adhesives suitable for biodegradable resins have not been found yet.

Patent Document 1: Japanese Laid-Open Patent Publications No. Hei 10-100353

Patent Document 2: Japanese Laid-Open Patent Publications No. 2001-130183,

Disclosure of the Invention

Problem That the Invention Is to Solve

For product packages, further improvement is

currently desired to achieve a simpler structure, simpler production process, lower product cost, lower production cost, higher package strength and better appearance. In other words, improvement of product packages having the laminate structure described above is required.

In view of the above, an object of the present invention is to overcome the above problems and to provide a package that can realize a simpler structure, simpler production process, lower product cost, lower production cost, excellent strength and excellent appearance.

Means for Solving the Problem

The package of the present invention is characterized by comprising a backing sheet including a light permeable base, a first printing layer, an anti-offset layer and a second printing layer laminated in this order on a first surface of the base; and a holding means for allowing the backing sheet to hold an article at the side of a second surface of the base.

It is effective that the holding means be a container bonded to the second surface with the article accommodating therein. In this case, it is effective that the container be bonded to the second surface by heat sealing.

It is also effective that at least one of the base and the container comprise a biodegradable plastic. An example of the biodegradable plastic is an aliphatic polyester.

An example of the aliphatic polyester is a polylactic polymer.

The present invention further relates to a method for producing a package comprising the steps of: (1) successively forming, on a first surface of a light permeable base, a first printing layer, an anti-offset layer and a second printing layer by a single printing step to give a backing sheet; and (2) allowing the backing sheet to hold an article at the side of a second surface of the base.

It is effective that, in the step (2), a container accommodating the article be integrated with the second surface to allow the backing sheet to hold the article. It is also effective that the container be bonded to the second surface by heat sealing.

Effects of the Invention

According to the present invention, because, on a first surface of a transparent light permeable base, both a printing layer that can be observed from the first surface and a printing layer that can be observed from a second surface of the base are formed, a laminate layer and an adhesive layer can be omitted. This yields a package that can achieve a simpler structure, simpler production process, lower product cost, lower production cost, higher package strength and better appearance.

Moreover, because the formation of a printing layer on the second surface of the base to be in contact with a

container can be avoided, a container can be bonded to not only a base made of a conventional general-purpose synthetic resin, but also, preferably, a base made of a biodegradable resin only by means of heat sealing.

Brief Description of Drawings

FIG. 1 is an exploded perspective view schematically illustrating an embodiment of a package according to the present invention.

FIG. 2 is a vertical cross sectional view of a package shown in FIG. 1 after assembled.

FIG. 3 is an exploded perspective view schematically illustrating another embodiment of a package according to the present invention.

FIG. 4 is a diagram showing test specimens for evaluating peeling strength.

FIG. 5 is a diagram showing how to evaluate abrasion resistance.

Best Mode for Carrying Out the Invention

The package of the present invention is characterized in that, on only one surface of a light permeable base, a first printing layer that can be observed from other surface of the base, an anti-offset layer and a second printing layer that can be observed from the one surface are formed, and that a holding means for holding an

article is provided at the side of a second surface of the base.

A package of the present invention will be described below with reference to the accompanying drawings.

FIG. 1 is an exploded perspective view schematically illustrating an embodiment of a package according to the present invention. As shown in FIG. 1, a package 1 of the present invention includes a backing sheet 2, a battery group 4 as an article and a container 3 for allowing the backing sheet 2 to hold the battery group 4.

FIG. 2 is a vertical cross sectional view of the package shown in FIG. 1 after assembled. As shown in FIG. 2, the package 1 of the present invention includes a light permeable base 2a, and a backing sheet 2 having a first printing layer 2b, an anti-offset layer 2c and a second printing layer 2d which are laminated in this order on a first surface of the base 2a. The package 1 further includes a container 3 as a holding means for allowing the backing sheet 2 to hold the article 4 at a second surface of the base 2a.

In a conventional package, a print is given on the front surface and the back surface of a base whereas in a package of the present invention, a print is given only on one surface. Specifically, on a first surface of a light permeable (transparent) base 2a are formed both a second printing layer 2d to be observed from the back surface of the backing sheet and a first printing layer 2b to be observed

from the front surface of the backing sheet.

In other words, in a package of the present invention, prints such as designs and instructions to be observed from the directions indicated by the arrows X and Y in FIG. 2 are given on the first surface of the base 2a. This structure can omit a laminate layer and an adhesive layer which are usually provided between the container 3 and the base 2a in a conventional package.

In order to prevent the first printing layer 2a from being observed through from the direction of the arrow Y, or conversely, to prevent the second printing layer 2d from being observed through from the direction of the arrow X (in other words, in order to prevent offsetting), an anti-offset layer 2c is provided between the first printing layer 2a and the second printing layer 2d. The anti-offset layer 2c should have a shielding effect enough to, for example, read a barcode contained in the first printing layer 2d.

The first printing layer 2a and the second printing layer 2d are formed using, for example, an ordinary ink such as ultraviolet curing (UV) ink. The first printing layer 2a and the second printing layer 2d have a thickness of about 4.0 to about 6.0 μm .

The anti-offset layer 2c may be formed with the same ink as the first printing layer 2a and the second printing layer 2d. The thickness and the composition thereof can be adjusted as long as the above shielding effect can be

exhibited. For example, the thickness thereof is preferably 10.0 to 15.0 μm , and it is preferably formed with a light impermeable white UV ink.

The first printing layer 2a and the second printing layer 2d are preferably formed by relief printing or gravure printing. As for the anti-offset layer 2c, it is preferably formed by flexographic printing because it should have a certain thickness to exhibit the shielding effect.

And, by bonding the container 3 and the base 2a of the backing sheet 2 by means of heat sealing to form a whole, the backing sheet 2 is allowed to hold the article 4 at the side of the second surface of the base 2a. The backing sheet 2 may have a hanging aperture 5 so that the package 1 can be hanged on a sale shelf for display.

The above-described backing sheet 2 in the present invention can be applied to other packages. FIG. 3 is an exploded perspective view schematically illustrating another embodiment of a package according to the present invention. The package 11 shown in FIG. 3 includes a backing sheet 12 and a transparent container 13. The container 13 accommodates a battery group 14 therein.

In this embodiment also, the same backing sheet as the backing sheet 2 of FIGS. 1 and 2 can be used as the backing sheet 12. Accordingly, a laminate layer and an adhesive layer are not formed on the surface of the backing sheet 12 to be in contact with the container 13, and folds 13a,

13b and 13c may be formed at the side opposite to the holder portion of the container 13.

More specifically, the periphery of the container 13 is folded by 180 degrees on the base 12 side to form the folds. In the direction of the alternate long and short dash lines (the arrow Z), the backing sheet 12 is slid into the folds 13a and 13c from the edges thereof. When the backing sheet 12 reaches the fold 13b, the backing sheet 12 and the container 13 are integrated.

Since the backing sheet 12 is merely inserted in the folds 13a, 13b and 13c of the container 13, the backing sheet 12 is preferably fixed with the folds 13a, 13b and 13c. Any means may be used to the fixing without particular limitation. Examples thereof include heat sealing, an adhesive and a stapler. Particularly, heat sealing is preferred.

Similar to the case of FIGs. 1 and 2, the backing sheet 12 may have a hanging aperture 15 so that the package 11 can be hanged on a sale shelf for display.

In the packages 1 and 11 shown in FIGs. 1 to 3, the base 2 for constituting the backing sheet 2 is transparent. It is further preferred that the containers 3 and 13 be transparent so that the design printed on the outer jacket of the batteries in the battery groups 4 and 14 can be observed by a user or a customer.

The backing sheet in the present invention is applicable not only to the packages using blister packs shown

in FIGs. 1 to 3, but also to those using so-called skin packs and shrink packs.

It is preferred that either of the base and the container in the package of the present invention be made of a biodegradable resin.

Examples of the biodegradable resin that can be used in the present invention include aliphatic polyester, modified polyvinyl alcohol (PVA), cellulose ester compounds and modified starch. Among them, the aliphatic polyester is environmentally preferred because alcohol and carboxylic acid generated therefrom during decomposition are extremely less toxic.

Examples of the aliphatic polyester include polymers produced by microorganism-mediated processes such as a hydroxybutyric acid-valeric acid polymer, synthetic polymers such as polycaprolactone and an aliphatic dicarboxylic acid-aliphatic diol condensate and semisynthetic polymers such as polylactic polymers.

From the viewpoint of excellent transparency, stiffness, heat resistance and workability, the polylactic polymers are preferably used. The polylactic polymer may be a homopolymer of L-lactic acid and/or D-lactic acid. Alternatively, it may be a copolymer or a mixture (or a polymer alloy) with other hydroxycarboxylic acids as long as its biodegradability is not impaired.

Examples of the other hydroxycarboxylic acids

include glycolic acid, 3-hydroxybutyric acid, 4-hydroxybutyric acid, 3-hydroxyvaleric acid, 4-hydroxyvaleric acid and 6-hydroxycaproic acid.

The polylactic polymer, a preferred biodegradable resin, preferably has, but not limited to, a weight-average molecular weight in a range of 50,000 to 300,000. When the weight-average molecular weight is less than 50,000, practical physical properties may hardly be exhibited. Conversely, when the weight-average molecular weight exceeds 300,000, melt viscosity may be too high, resulting in poor moldability.

The polylactic polymer has a high glass transition point and high crystallinity, and it has characteristics similar to those of polyethylene terephthalate (PET). Further, a film made of the polylactic acid can be uniaxially or biaxially drawn (stretched). The resulting drawn sheet, in which molecules are oriented, is low in brittleness, hard to crack and extremely favorable in strength. Moreover, the polylactic polymer film can be formed by extrusion casting, which ensures transparency of the film. In the present invention, a drawn sheet is preferably used as a material to produce a container particularly by vacuum/pressure forming, which will be described later.

A raw material for the polylactic polymer may be corn. Starch is separated from corn and then converted into sugar. Lactic acid is then obtained by lactic acid fermentation, which is converted into lactide, and then

polymerized into polylactic acid. As just described, the polylactic polymer can be made without using petroleum materials. Therefore, according to the present invention, the final resulting battery package as well as the preparation process of the raw material are environmentally friendly.

The biodegradable resin may be a resin composition. In this case, the biodegradable resin may be mixed with other polymeric materials as long as the effect of the present invention is not impaired. Alternatively, in order to control the physical properties and workability, the biodegradable resin may be mixed with a plasticizer, a lubricant, an inorganic filler, an ultraviolet absorber, a heat stabilizer, a light stabilizer, a light absorber, a coloring agent, a pigment and a modifier.

In particular, it is necessary to mold the container of the battery package to have a holder portion, which is relatively precisely designed to fit the battery shape. In other words, the container requires not only the transparency but also moldability. However, since the biodegradable resin has brittleness, it may be cracked under the conventional molding conditions.

To solve the problem, in the present invention, it is preferred to form the container using a drawn sheet of biodegradable resin. Due to the drawing, the resulting sheet has improved brittleness and improved strength. Thereby, a container highly resistant to cracking can be produced. A

biaxially drawn sheet is more preferred than a uniaxially drawn sheet because a biaxially drawn sheet has higher strength. This drawn sheet is formed into a container by a conventional method.

The drawn sheet preferably has a tensile strength (breaking strength) of 40 to 90 MPa. When the tensile strength is less than 40 MPa, sufficient strength to carry the battery cannot be obtained. Conversely, when the tensile strength is greater than 90 MPa, the sheet strength will be too high, decreasing moldability and transparency of the sheet. Particularly preferred is 60 to 80 MPa. The tensile strength in the present invention is measured according to JIS K-7127 in which a Type 2 test specimen is used and measurement is made at a test rate of 200 mm/min.

Further, the drawn sheet preferably has a tensile elasticity of 1 to 7 GPa. When the drawn sheet has a tensile elasticity of less than 1 GPa, the sheet will be too stiff, decreasing moldability of the sheet. When the drawn sheet has a tensile elasticity exceeding 7 GPa, the sheet will be too soft, which may cause difficulty in carrying the battery. Particularly preferred is 2 to 6 GPa. The tensile elasticity can be measured according to JIS K 7127.

As an index of the sheet transparency, the drawn sheet preferably has a haze of less than 15%. When the haze is not less than 15%, the sheet will have decreased transparency, losing the inherent function of the package.

Particularly preferred is 2 to 12%. The haze is measured according to JIS K-7105.

The container can accommodate a battery group including a plurality of batteries wrapped in a shrink pack as an article. This shrink pack is also preferably made of a biodegradable aliphatic polyester. The biodegradable aliphatic polyester is preferably a polylactic polymer. The shrink pack is preferably formed of a drawn sheet of the biodegradable aliphatic polyester.

The base of the package according to the present invention preferably has a thickness of 50 to 200 μm . When the base has a thickness of less than 50 μm , the resulting sheet will be too thin, which may cause difficulty in carrying the article. When the base has a thickness exceeding 200 μm , thermal conductivity will be decreased, causing variations in adhesion strength when the base and the container are heat-sealed, resulting in a final package of lower quality. Besides, it is difficult to control heat during the heat sealing process.

The package according to the present invention is produced by the steps of: (1) successively forming, on a first surface of a light permeable base, a first printing layer, an anti-offset layer and a second printing layer by a single printing step to give a backing sheet; and (2) allowing the backing sheet to hold an article at the side of a second surface of the base.

Example

The present invention will be described in further detail below with reference to examples, but it is to be understood that the present invention is not limited thereto.

Example 1

In this example, a package according to the present invention having the structure shown in FIGs. 1 and 2 was produced.

As the light permeable base 2a, a 150 μm thick translucent drawn sheet made of polylactic acid (PLA) was prepared. The base had a tensile strength (breaking strength) of 110 MPa both in length and width directions, and a tensile elasticity of 3.8 GPa in length direction and 4.3 GPa in width direction. The heat shrinkage of the base was measured according to JIS Z 1712 in which a test specimen was heated at 120°C for 5 minutes. As a result, the base had a heat shrinkage of 2.7% in length direction and 0.3% in width direction.

On one surface of the base 2a were successively formed a 5 μm thick first printing layer 2b made of UV ink by relief printing, a 12 μm thick anti-offset layer 2c made of UV ink by flexographic printing, and a 5 μm thick second printing layer 2d by relief printing in a single rotary printing step. Thus, a backing sheet 2 was obtained.

Subsequently, a 250 μm thick transparent drawn sheet made of PLA was prepared. The drawn sheet had a tensile strength (breaking strength) of 66 MPa in length direction and 65 MPa in width direction, a tensile elasticity of 3.2 GPa in length direction and 3.1 GPa in width direction, and a haze of 10%. The heat shrinkage of the drawn sheet was measured according to JIS Z 1712 in which a test specimen was heated at 120°C for 5 minutes. As a result, the drawn sheet had a heat shrinkage of 3.7% in length direction and 1.7% in width direction. This drawn sheet was molded into a container 3 having the shape shown in FIGs. 1 and 2.

Finally, a battery group 4 (shrink-packed) including four cylindrical AA batteries was prepared. The battery group 4 was housed in the holder portion of the container 3. The brim of the container 3 and the base 2a of the backing sheet 2 were bonded by heat sealing at a heating temperature of 100°C. Thus, a package "A" according to the present invention was produced.

Example 2

A package "B" according to the present invention was produced in the same manner as in Example 1 except that the base 2a of the backing sheet 2 and the container 3 were made using a drawn sheet of polyethylene terephthalate (PET) having a tensile strength (breaking strength) of 68 MPa both in length and width directions, a tensile elasticity of 2.1 GPa

in length direction and 2.2 GPa in width direction, and a haze of less than 1%, instead of using a drawn sheet of PLA.

Comparative Example 1

A package "C" for comparison was produced in the same manner as in Example 1 except for the following points. A first printing layer was formed on the second surface of the base 2a by relief printing. A 50 μm thick transparent drawn sheet made of PLA serving as a laminate layer was bonded on the first printing layer using a polyamide adhesive. Further, a second printing layer was formed on the first surface of the base 2a by relief printing. Finally, the laminate layer and the container were bonded by heat sealing.

Comparative Example 2

A package "D" for comparison was produced in the same manner as in Example 1 except that the anti-offset layer by flexographic printing was not formed.

[Evaluation]

(1) Peeling Strength

Peeling strength was measured as follows. A test specimen 21 obtained by cutting the backing sheet of each package into a strip with a width of 10 mm and a test specimen 22 obtained by cutting the drawn sheet

constituting the container of each package into a strip with a width of 10 mm were bonded with a 6 mm long overlap 23 by heat sealing as shown in FIG. 4. FIG. 4 is a diagram showing test specimens for evaluating peeling strength.

Then, a so-called T type peeling test was performed using a digital force gauge available from IMADA Co., Ltd. Specifically, the ends of the test specimens were pulled in opposite directions as shown in FIG. 4 at a rate of 200 mm/min, during which strength necessary for the peeling was measured. The results are shown in Table 1. A larger value is preferred because the larger the value, the higher the peeling strength.

(2) Abrasion Resistance

The abrasion resistance of the back surface of the backing sheet 2 (the first surface side of the base 2a), that is, the surface to which the container 3 was not bonded, was evaluated. As shown in FIG. 5, a corrugated cardboard 25, from which boxes used for packing and transporting the battery packages would be made, was adhered to a 0.9 kg weight 24 to give a slider 26. FIG. 5 is a diagram showing how to evaluate abrasion resistance.

The backing sheet 2 of each package was fixed. The slider 26 was then moved back and forth 500 times on the backing sheet 2, after which assessment was made. A rating of "○" was given when letters of the second printing layer was clearly seen. A rating of "△" was given when they were a

little difficult to be seen. A rating of "×" was given when they were unreadable. The results are shown in Table 1.

(3) Degree of offset

Each of the packages "A" to "D" was visually checked from both the front surface side and the back surface side to see whether the second printing layer and the second printing layer were unintentionally transferred, i.e. whether an offset was seen. A rating of "○" was given when no offset was seen. A rating of "△" was given when a slight offset was seen. A rating of "×" was given when the degree of offset was high. The results are shown in Table 1.

Table 1

	Components of backing sheet	Peeling strength	Abrasion resistance	Offset
			0.9 Kg	
Ex. 1	Second printing layer/ Anti-offset layer/ First printing layer/Base (PLA)	15.3 N	○	○
Ex. 2	Second printing layer/ Anti-offset layer/ First printing layer/Base (PET)	13.5 N	○	○
Comp. Ex. 1	Second printing layer/ Base (PLA)/First printing layer/ Laminate layer	10.1 N	○	○
Comp. Ex. 2	Second printing layer/ First printing layer/Base (PLA)	15.3 N	○	△

Table 1 shows the components of backing sheet, the peeling strength, the abrasion resistance and the degree of offset for the packages "A" to "D". It is clear, from Table 1, that the packages "A" and "B" of Examples 1 and 2 of the present invention were excellent on all items.

Industrial Applicability

The above-described package according to the present invention having excellent strength and excellent abrasion resistance can be produced by a simpler method than a conventional method. Further, the package according to the present invention is effectively used as a package capable of containing any article including batteries and of being hanged at stores and shops. Particularly, because a biodegradable resin can be used as the material, the package according to the present invention is preferably used as an environmentally friendly package.